

Our Ref: 217500_LET_005.docx

19 December 2018

Lithgow City Council
PO Box 19,
180 Mort Street
Lithgow NSW 2790

Attention: Nigel Campbell, Waste & Recycling Coordinator

ENVIRONMENTAL MONITORING OF LITHGOW SOLID WASTE FACILITY

Geolyse has completed scheduled groundwater and accumulated landfill gas monitoring at Lithgow Solid Waste Facility, located off Geordie Street, Lithgow on 13 November 2018. Leachate discharge monitoring from point LW1 was also conducted.

Groundwater Levels

Groundwater was gauged at six (6) groundwater monitoring wells across the site. Groundwater gauging data is included in **Table 1** (attached), and elevation trends are shown on **Figure 1**. No groundwater was recorded in monitoring stations MB1, MB6, MB11 and MB13. Observations were as follows:

- Depths to groundwater ranged from 3.29 metres below ground level (mbgl) at MB14, to 13.84 mbgl at MB9. Corrected groundwater elevations ranged from 897.28 metres Australian Height Datum (mAHD) at MB14, to 934.89 mAHD at MB6B.
- Inference of groundwater elevations, calculated from available survey data from installed groundwater monitoring wells indicate a flow direction to the south-west.

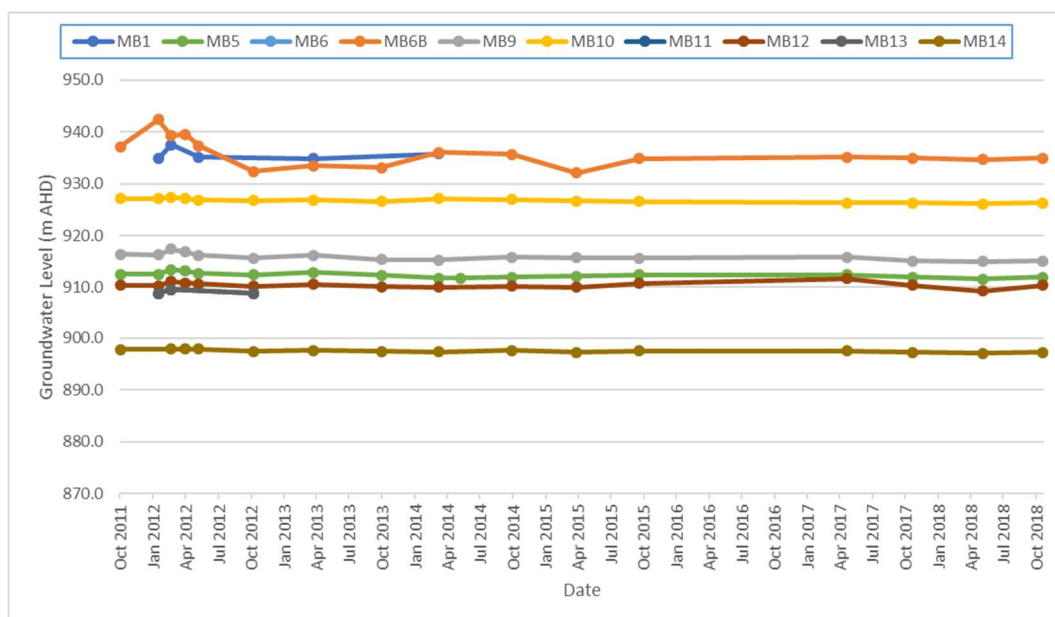


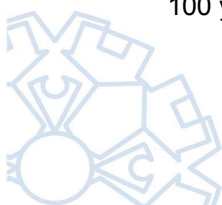
Figure 1: Lithgow Solid Waste Facility – Groundwater Elevations

Groundwater Quality

Groundwater samples were able to be collected from wells MB5, MB6B, MB9, MB10, MB12 and MB14. Samples were couriered to SGS Laboratories in Alexandria, NSW, who are NATA accredited to perform the scheduled analysis. Results of analysis are included in **Table 2** (attached), and laboratory certificates have also been appended to this letter.

Groundwater quality has been assessed by comparison to criteria (where available) adopted from Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000 – Primary Industries: Water quality for irrigation and general water use.

- Laboratory measured pH ranged from 5.0 at MB12 to 6.6 at MB14. pH of groundwater at MB9 (pH of 5.8), MB10 (pH of 5.8) and MB12 was below the guideline range considered suitable for pumping, irrigation and stock watering (6.0 to 8.5 pH units).
- Electrical conductivity (EC) ranged from 210 $\mu\text{S}/\text{cm}$ at piezometer MB10 to 1,200 $\mu\text{S}/\text{cm}$ at piezometer MB6B.
- Total dissolved solids (TDS) ranged from 130 mg/L at MB10 to 800 mg/L at MB6B. TDS concentrations were below the livestock watering 'loss of production' tolerance limit for the most susceptible livestock category, poultry (3,000 mg/L – ANZECC & ARMCANZ, 2000).
- The chemical oxygen demand (COD) of groundwater samples ranged from below the laboratory limit of reporting (LOR) of 10 mg/L at MB9, MB10 and MB14, to 27 mg/L at MB6B.
- Total alkalinity in groundwater ranged from 46 mg/L at MB10 to 320 mg/L at MB6B. Alkalinity of groundwater was below the guideline hardness value for potential fouling of waters (350 mg/L).
- Groundwater chloride concentrations ranged from 25 mg/L at MB10 to 230 mg/L at MB12. All concentrations were below the guideline value for protection of moderately sensitive crops (350 mg/L).
- Fluoride concentrations in groundwater were all below the laboratory LOR of 0.1 mg/L with the exception of MB6B (0.11 mg/L). All concentrations were below the guideline value of 1 mg/L for long term irrigation use (up to 100 years).
- Sulfate concentrations in groundwater ranged from 13 mg/L at MB10 to 85 mg/L at MB12.
- Calcium concentrations ranged from 11 mg/L at MB10 to 90 mg/L at MB14.
- Magnesium concentrations ranged from 8.5 mg/L at MB10 to 56 mg/L at MB6B.
- Potassium concentrations ranged from 3.2 mg/L at MB10 to 49 mg/L at MB5.
- Concentrations of sodium ranged from 10 mg/L at MB10, to 92 mg/L at MB5. Sodium concentrations were below the guideline level for irrigation to moderately sensitive crops (<230 mg/L).
- Ammonia concentrations in groundwater ranged from 0.2 mgN/L at MB14 to 11 mgN/L at MB5.
- Nitrate concentrations ranged from below the laboratory LOR of 0.005 mgN/L at MB6B, MB9, MB12 and MB14, to 0.27 mgN/L at MB10.
- Phosphorus concentrations in groundwater ranged from below the laboratory LOR of 0.02 mg/L at MB10, MB12 and MB14, to 0.19 mg/L at MB6B. Phosphorus concentrations at MB5, MB6B, and MB9 were above the guideline value of 0.05 mg/L for long term irrigation use (up to 100 years).



- Aluminium concentrations in groundwater were generally recorded at or below the laboratory LOR of 5 µg/L with the exception of MB12, which recorded a concentration of 380 µg/L. Aluminium concentrations in groundwater were below the long-term (up to 100 years) irrigation guideline concentration of 5,000 µg/L.
- Hexavalent chromium concentrations were below the laboratory LOR and 0.004 mg/L at all groundwater monitoring locations, and total chromium in groundwater was recorded at a maximum concentration of 4 µg/L at MB5. All concentrations were lower than the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Iron concentrations ranged from 84 µg/L at MB5 to 37,000 µg/L at MB12. Iron concentrations at MB6B, MB9, MB10, MB12 and MB14 exceeded the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Manganese concentrations ranged from 56 µg/L at MB10 to 3,400 µg/L at MB6B. Manganese concentrations at locations MB5, MB6B, MB9 and MB12 the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Total phenols were below the laboratory LOR of 0.01 mg/L at all groundwater monitoring points.
- Total organic carbon (TOC) in groundwater ranged from 1.5 mg/L at MB10 to 6.0 mg/L at MB6B.
- Organochlorine pesticides and organophosphorus pesticides were below respective laboratory LORs at all groundwater monitoring points.
- Total petroleum hydrocarbons (TPH) and total recoverable hydrocarbons (TRH) were below respective laboratory LORs at all groundwater monitoring points for all fractions, with the exception of MB12 which recorded a TPH C6-C9 fraction and TRH C6-C10 fraction of 130 µg/L.

Leachate

The leachate sample collected from LW1 was couriered to SGS Laboratories in Alexandria, NSW, who are NATA accredited to perform the scheduled analysis. Results of analysis are included in **Table 3** (attached), and laboratory certificates have also been appended to this letter.

Leachate quality has been assessed by comparison to criteria (where available) adopted from Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000 – Primary Industries: Water quality for irrigation and general water use.

- Laboratory measured pH was slightly alkaline, recorded at 6.6, noted to be near-neutral.
- Electrical conductivity (EC) was recorded to be 1,100 µS/cm.
- The total dissolved solids (TDS) concentration was recorded to be 600 mg/L, below the livestock watering 'loss of production' tolerance limit for the most susceptible livestock category, poultry (3,000 mg/L – ANZECC & ARMCANZ, 2000).
- Total suspended solids (TSS) were recorded to be 5 mg/L in the leachate sample.
- The chemical oxygen demand (COD) was recorded to be 15 mg/L.
- The biochemical oxygen demand (BOD) was recorded to be less than the laboratory limit of reporting (LOR) of 5 mg/L. High COD relative to BOD may be indicative of the presence of non-biodegradable organic matter (e.g. oils, humic substances, organic polymers).
- Total alkalinity was recorded at 140 mg/L, which was below the guideline hardness value for potential fouling of waters (350 mg/L).
- The recorded chloride concentration was 230 mg/L, and below the guideline value for protection of moderately sensitive crops (350 mg/L).



- The fluoride concentration of leachate was less than the laboratory LOR of 0.17 mg/L, below the guideline value of 1 mg/L for long term irrigation use (up to 100 years).
- The leachate sulphate concentration was recorded to be 18 mg/L.
- Calcium in leachate was recorded to be 58 mg/L.
- Magnesium in leachate was recorded to be 20 mg/L.
- Potassium in leachate was recorded to be 29 mg/L.
- Sodium in leachate was recorded to be 97 mg/L. The sodium concentration was below the guideline level for irrigation to moderately sensitive crops (230 mg/L).
- Total organic carbon (TOC) was recorded at 5.5 mg/L.
- The ammonia concentration of leachate was recorded to be 0.18 mgN/L.
- The nitrate concentration of leachate was recorded to be 0.53 mgN/L.
- Iron in leachate was recorded to be 62 µg/L, and below the long term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Manganese in leachate was recorded to be 620 µg/L, and above the long term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Total phenolics in leachate were below the laboratory LOR of 0.01 mg/L.

Accumulated Landfill Gas Monitoring

Gas concentrations in buildings and sheds within the required monitoring distance of 250 metres of filled areas were all below the respective threshold concentration of 1.25 % (v/v) during the monthly monitoring rounds conducted in September 2018 to December 2018. Results of gas monitoring are included in **Table 4** (attached)

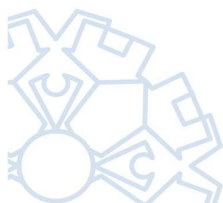
The next routine monitoring for groundwater and leachate is scheduled for February 2019. Surface water monitoring is required to take place any calendar month when a surface water discharge is recorded. Please do not hesitate to contact us with any questions or comments you may have regarding this report.

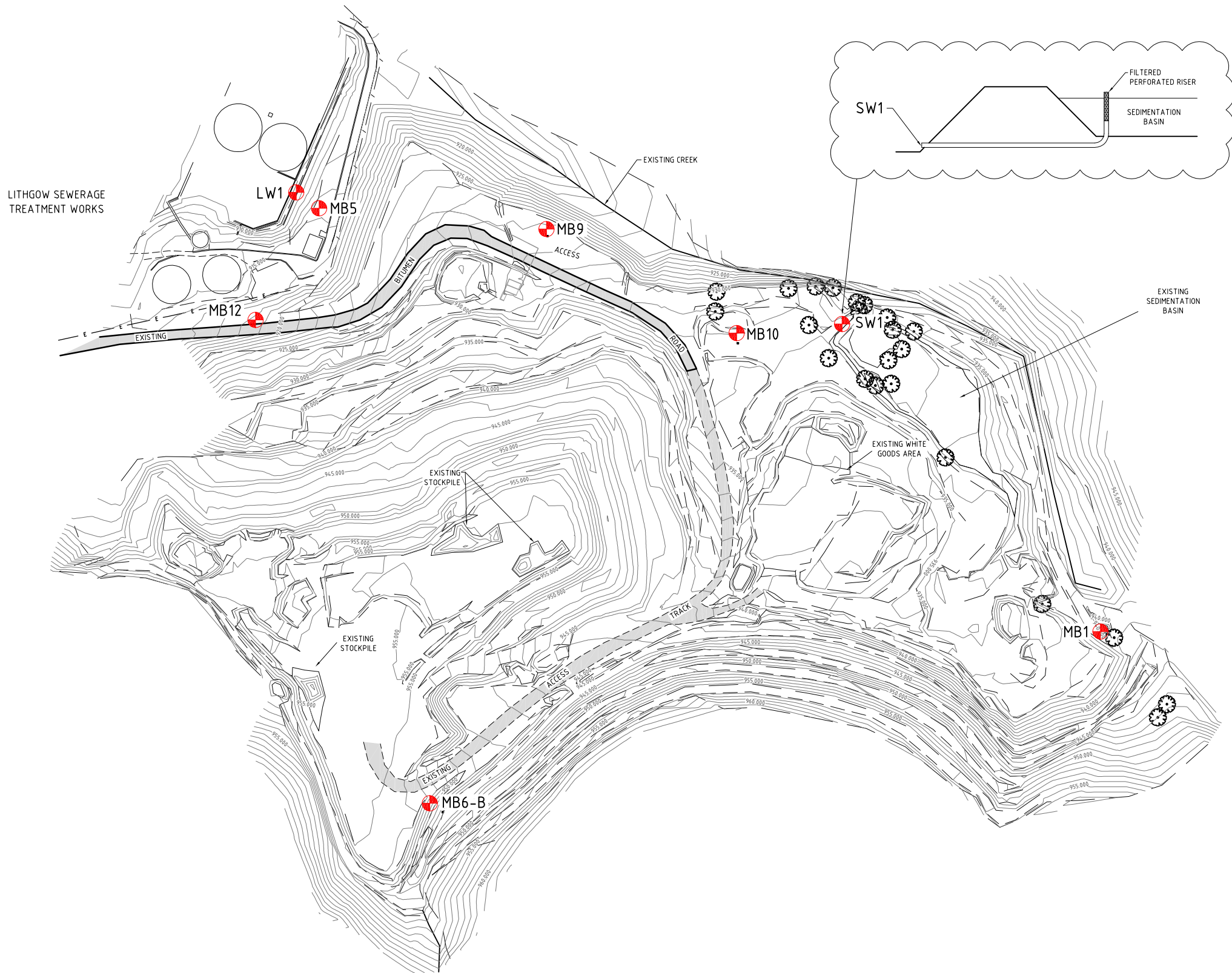
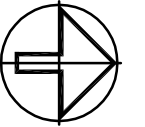
Yours faithfully
Geolyse Pty Ltd



BRENDAN STUART
Environmental Scientist

No. of Attachments – 6: Environmental Monitoring Point Locations
Table 1 – Groundwater Level Measurements
Table 2 – Results of Laboratory Analyses (Groundwater) – November 2018
Table 3 – Results of Laboratory Analyses (Leachate) – November 2018
Table 4 – Accumulated Landfill Gas Monitoring
SGS Laboratories Analytical Reports – November 2018






EPA MONITORING POINTS		
EPA ID No.	LOCATION	TYPE
1	MB1	GROUNDWATER
2	MB5	GROUNDWATER
3	MB6-B	GROUNDWATER
4	MB9	GROUNDWATER
5	MB10	GROUNDWATER
6	SW1	AMBIENT WATER
7	MB12	GROUNDWATER
8	MB14	GROUNDWATER
9	LW1	LEACHATE
10		LANDFILL GAS

- NOTES:
- THIS PLAN IS PREPARED FROM A FIELD SURVEY FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS ON THE LAND AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
 - VISIBLE SERVICES HAVE BEEN LOCATED ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITIES SHOULD BE CONTACTED FOR LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES.
 - CONTOUR INTERVAL 1m.
 - THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.

- LEGEND:
- EXISTING TOP OF BANK
 - EXISTING BOTTOM OF BANK
 - EXISTING TRACK
 - EXISTING ELECTRICITY
 - EXISTING FENCE
 - EXISTING VEGETATION
 - EXISTING ACCESS ROAD

SCALE 1:1500(A1)
SCALE 1:3000(A3)



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No	DATE	DRAFTING CHECK	PM CHECK	DETAILS
A	27/06/11	LP	AB	WORKING DRAFT
B	28/09/11	LP	AB	EPL VARIATION

PROJECT

**LITHGOW SOLID WASTE FACILITY
LANDFILL ENVIRONMENTAL
MANAGEMENT PLAN**

FILE REFERENCE: 0:\Projects\211109\04\1\Cad\Lithgow\211109_04B_EV01-EV09.dwg

APPROVAL AUTHORITY

ENVIRONMENTAL PROTECTION AUTHORITY
EPL : 6004

CLIENT



CITY OF LITHGOW COUNCIL

DRAWING

**ENVIRONMENTAL MONITORING
POINTS**

PROJECT NUMBER: 211109 DRAWING NUMBER: 01B_EV04 REV. B

SOURCE: CRAVEN, ELLISTON & HAYES (LITHGOW) PTY. LTD. (DRAWING No. E668-10, DATED 19/04/2010)



TABLE 1: LITHGOW SOLID WASTE FACILITY - GROUNDWATER LEVEL RESULTS

Ground Water Levels: 13-Nov-18

Piezometer Details:

	Ground Elev (mAHD)	Stickup (m)	Elevation Top PVC (mAHD)	Date	Measured (m)	GWL (mAHD)	Well Depth (m)	Well Base (mAHD)	Water Column (m)
MB1	939.790	0.86	940.650	13/11/2018	NMWL	-	6.5	934.15	nil
MB5	914.940	0.80	915.740	13/11/2018	3.80	911.94	9.8	905.94	6.00
MB6	945.820	0.85	946.670	13/11/2018	NMWL	-	-	-	nil
MB6B	946.290	0.75	947.040	13/11/2018	12.15	934.89	19.3	927.74	7.15
MB9	928.260	0.69	928.950	13/11/2018	13.84	915.11	17.1	911.85	3.26
MB10	932.180	0.73	932.910	13/11/2018	6.63	926.28	13.7	919.21	7.07
MB11	915.010	0.67	915.680	13/11/2018	NMWL	-	17.9	897.82	nil
MB12	918.330	0.76	919.090	13/11/2018	8.70	910.39	22.3	896.84	13.55
MB13	914.980	0.70	915.680	13/11/2018	NMWL	-	39.4	876.28	nil
MB14	899.790	0.78	900.570	13/11/2018	3.29	897.28	17.7	882.87	14.41

Definitions:

Stickup:	Height of piezometer pipe above ground surface.
Ground Elev:	Actual elevation of ground at the piezometer relative to an arbitrary datum. All ground elevations are measured to the same datum, hence Piezo GWLs are relative to each other.
GWL:	Actual elevation of groundwater at the piezometer relative to an arbitrary datum.
Measured:	Depth of groundwater measured from the top of the piezometer pipe.

Date	MB1		MB5		MB6		MB6B		MB9		MB10		MB11		MB12		MB13		MB14	
	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)
25-Oct-11	NMWL		3.20	912.54	NMWL		9.92	937.12	12.62	916.33	5.77	927.14	NMWL		8.69	910.40	NMWL		2.80	897.77
8-Feb-12	5.85	934.80	3.26	912.48	NMWL		4.68	942.36	12.71	916.24	5.83	927.08	6.87	908.81	8.77	910.32	6.89	908.79	NMWL	
15-Mar-12	3.11	937.54	2.29	913.45	NMWL		7.82	939.22	11.56	917.39	5.51	927.40	6.08	909.60	7.95	911.14	6.11	909.57	2.64	897.93
24-Apr-12	NMWL		2.55	913.19	NMWL		7.47	939.57	12.10	916.85	5.78	927.13	NMWL		8.24	910.85	NMWL		2.67	897.90
31-May-12	5.55	935.10	3.07	912.67	NMWL		9.71	937.33	12.73	916.22	6.04	926.87	NMWL		8.43	910.66	NMWL		2.64	897.93
30-Oct-12	NMWL		3.29	912.45	NMWL		14.64	932.40	13.33	915.62	6.19	926.72	6.83	908.85	8.90	910.19	6.87	908.81	3.11	897.46
17-Apr-13	5.81	934.84	2.87	912.87	NMWL		13.55	933.49	12.80	916.15	6.10	926.81	NMWL		8.50	910.59	NMWL		2.91	897.66
23-Oct-13	NMWL		3.44	912.30	NMWL		13.97	933.07	13.60	915.35	6.35	926.56	NMWL		9.01	910.08	NMWL		3.09	897.48
2-Apr-14	4.90	935.75	3.98	911.76	NMWL		11.00	936.04	13.66	915.29	5.75	927.16	NMWL		9.04	910.05	NMWL		3.20	897.37
2-Jun-14	NMWL		3.96	911.78	NMWL		NMWL		NMWL		NMWL		NMWL		NMWL		NMWL		NMWL	
21-Oct-14	NMWL		3.81	911.93	NMWL		11.41	935.63	13.13	915.82	6.01	926.90	NMWL		8.89	910.20	NMWL		2.97	897.60
21-Apr-15	NMWL		3.56	912.18	NMWL		14.98	932.06	13.19	915.76	6.26	926.65	NMWL		9.06	910.03	NMWL		3.27	897.30
13-Oct-15	NMWL		3.34	912.40	NMWL		12.18	934.86	13.30	915.65	6.30	926.61	NMWL		8.35	910.74	NMWL		3.06	897.51
15-May-17	6.36		3.37	912.38	NMWL		11.88	935.16	13.09	915.86	6.58	926.34	NMWL		7.45	911.64	NMWL		3.05	897.52
13-Nov-17	NMWL		3.80	911.94	NMWL		12.15	934.89	13.84	915.11	6.63	926.28	NMWL		8.70	910.39	NMWL		3.29	897.28
29-May-18	NMWL		4.19	911.55	NMWL		12.38	934.66	13.99	914.96	6.83	926.08	NMWL		9.84	909.25	NMWL		3.50	897.07
13-Nov-18	NMWL		3.80	911.94	NMWL		12.15	934.89	13.84	915.11	6.63	926.28	NMWL		8.70	910.39	NMWL		3.29	897.28

**TABLE 2: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS
NOVEMBER 2018**

GROUNDWATER



				Sample ID Sample Date	MB5	MB6-B	MB9	MB10	MB12	MB14
					13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018
Group	Analyte	LOR	Units	Criteria	PS	PS	PS	PS	PS	PS
Physical Parameters	pH (Lab)	0	No unit	6.0 - 8.5	6.1	6	5.8	5.8	5	6.6
	Electrical Conductivity (Lab)	2	µS/cm	4478	1200	1200	410	210	1000	720
	Total Dissolved Solids	10	mg/L	-	680	800	270	130	640	440
	Chemical Oxygen Demand	10	mg/L	-	18	27	< 10	< 10	16	< 10
Alkalinity	Bicarbonate Alkalinity as CaCO ₃	5	mg/L	-	220	320	98	46	48	300
	Total Alkalinity as CaCO ₃	5	mg/L	350	220	320	98	46	48	300
Anions	Chloride	1	mg/L	350	190	180	55	25	230	34
	Fluoride	0.1	mg/L	1	< 0.1	0.11	< 0.1	< 0.1	< 0.1	< 0.1
	Sulfate (SO ₄)	1	mg/L	-	17	35	19	13	85	44
Cations	Calcium (Ca)	0.2	mg/L	1000	60	71	17	11	36	90
	Magnesium (Mg)	0.1	mg/L	-	21	56	14	8.5	24	28
	Potassium (K)	0.1	mg/L	-	49	14	7.8	3.2	9.2	8.9
	Sodium (Na)	0.5	mg/L	230	92	50	27	10	56	18
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-	5.8	6	3.5	1.5	4.5	3.4
Nutrients	Ammonia (NH ₃) as N	0.01	mg/L	-	11	0.9	1.7	0.64	2.7	0.2
	Nitrate (NO ₃) as N	0.005	mg/L	-	10	< 0.005	< 0.005	0.27	< 0.005	< 0.005
	Total Phosphorus	0.02	mg/L	0.05	0.18	0.19	0.07	< 0.02	< 0.02	< 0.02
Trace Metals	Hexavalent Chromium (Cr-VI)	0.004	mg/L	0.1	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
	Chromium (Cr)	1	µg/L	-	4	3	1	< 1	< 1	< 1
	Aluminium (Al)	5	µg/L	5000	< 5	< 5	< 5	5	380	< 5
	Iron (Fe)	5	µg/L	200	84	580	1700	360	37000	1000
	Manganese (Mn)	1	µg/L	200	750	3400	960	56	2100	76
Phenolics	Total Phenols	0.01	mg/L	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

**TABLE 2: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS
NOVEMBER 2018**

GROUNDWATER



				Sample ID Sample Date	MB5	MB6-B	MB9	MB10	MB12	MB14
					13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018
Group	Analyte	LOR	Units	Criteria	PS	PS	PS	PS	PS	PS
OC Pesticides	Aldrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha Chlordane	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha Endosulfan	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Beta BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Beta Endosulfan	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Delta BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Dieldrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endosulfan sulphate	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin aldehyde	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin ketone	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Heptachlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Heptachlor epoxide	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Hexachlorobenzene (HCB)	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Lindane (gamma BHC)	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Methoxychlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDD	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDE	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDT	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDD	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDT	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDE	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Gamma Chlordane	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	trans-Nonachlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Isodrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Mirex	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

**TABLE 2: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS
NOVEMBER 2018**

GROUNDWATER



				Sample ID Sample Date	MB5	MB6-B	MB9	MB10	MB12	MB14
					13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018	13/11/2018
Group	Analyte	LOR	Units	Criteria	PS	PS	PS	PS	PS	PS
OP Pesticides	Azinphos-methyl	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Bromophos Ethyl	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Chlorpyrifos (Chlorpyrifos Ethyl)	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Diazinon (Dimpylate)	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Dichlorvos	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Dimethoate	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Ethion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Fenitrothion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Malathion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Parathion-ethyl (Parathion)	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Methidathion	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total Petroleum Hydrocarbons	TRH C6-C9	40	µg/L	-	< 40	< 40	< 40	< 40	130	< 40
	TRH C10-C14	50	µg/L	-	< 50	< 50	< 50	< 50	< 50	< 50
	TRH C15-C28	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	< 200
	TRH C29-C36	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	< 200
	TRH C10-C36	450	µg/L	-	< 450	< 450	< 450	< 450	< 450	< 450
	TRH C37-C40	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	< 200
Total Recoverable Hydrocarbons	TRH C6-C10	50	µg/L	-	< 50	< 50	< 50	< 50	130	< 50
	TRH C6-C10 minus BTEX (F1)	50	µg/L	-	< 50	< 50	< 50	< 50	130	< 50
	TRH >C10-C16 (F2)	60	µg/L	-	< 60	< 60	< 60	< 60	< 60	< 60
	TRH >C16-C34 (F3)	500	µg/L	-	< 500	< 500	< 500	< 500	< 500	< 500
	TRH >C34-C40 (F4)	500	µg/L	-	< 500	< 500	< 500	< 500	< 500	< 500
	TRH C10-C40	650	µg/L	-	< 650	< 650	< 650	< 650	< 650	< 650
BTEXN Analytes	Benzene (F0)	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

mg/L milligrams per litre
µg/L micrograms per litre
µS/cm microsiemens per centimetre
LOR limit of reporting
PS primary sample

Criteria Criteria adopted from *Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality* - 'Primary Industries: Water quality for irrigation and general water use', 2000

within criteria
criteria exceeded

**TABLE 3: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS
NOVEMBER 2018**

LEACHATE



Group	Analyte	LOR	Units	Criteria	Sample ID
					Sample Date
					LW1
					13/11/2018
					PS
Physical Parameters	pH (Lab)	0	No unit	6.0 - 8.5	6.6
	Electrical Conductivity (Lab)	2	µS/cm	4478	1100
	Total Dissolved Solids	10	mg/L	-	600
	Total Suspended Solids	5	mg/L	-	5
	Chemical Oxygen Demand	10	mg/L	-	15
	Biochemical Oxygen Demand (BOD5)	5	mg/L	-	< 5
	Oil and Grease	5	mg/L	-	< 5
Alkalinity	Bicarbonate Alkalinity as CaCO3	5	mg/L	-	140
	Total Alkalinity as CaCO3	5	mg/L	350	140
Anions	Chloride	1	mg/L	350	230
	Fluoride	0.1	mg/L	1	0.17
	Sulfate (SO4)	1	mg/L	-	18
Cations	Calcium (Ca)	0.2	mg/L	1000	58
	Magnesium (Mg)	0.1	mg/L	-	20
	Potassium (K)	0.1	mg/L	-	29
	Sodium (Na)	0.5	mg/L	230	97
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-	5.5
Nutrients	Ammonia (NH3) as N	0.01	mg/L	-	0.18
	Nitrate (NO3) as N	0.005	mg/L	-	0.53
	Total Kjeldahl Nitrogen	0.05	mg/L	-	0.43
Trace Metals	Iron (Fe)	5	µg/L	200	62
	Manganese (Mn)	1	µg/L	200	620
Phenolics	Total Phenols	0.01	mg/L	-	< 0.01

mg/L milligrams per litre
 µg/L micrograms per litre
 µS/cm microsiemens per centimetre
 LOR limit of reporting
 PS primary sample
 Criteria Criteria adopted from *Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality* - 'Primary Industries: Water quality for irrigation and general water use', 2000

within criteria
 criteria exceeded

**TABLE 4: LITHGOW SOLID WASTE FACILITY - ACCUMULATED LANDFILL GAS MONITORING
METHANE (as %, v/v)**



		Date	18/07/2018	22/08/2018	5/09/2018	29/10/2018	15/11/2018	6/12/2018
Location	LOR	Units						
Site Shed	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Weighbridge	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Office (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Green Shed (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Pump Room (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

LOR limit of reporting

CLIENT DETAILS

Contact **Brendan Stuart**
 Client **GEOLYSE PTY LIMITED**
 Address **PO BOX 1963
 NSW 2800**

Telephone **61 2 68841525**
 Facsimile **(Not specified)**
 Email **bstuart@geolyse.com**

Project **217500 - Lithgow SWF**
 Order Number **(Not specified)**
 Samples **6**

LABORATORY DETAILS

Manager **Huong Crawford**
 Laboratory **SGS Alexandria Environmental**
 Address **Unit 16, 33 Maddox St
 Alexandria NSW 2015**

Telephone **+61 2 8594 0400**
 Facsimile **+61 2 8594 0499**
 Email **au.environmental.sydney@sgs.com**

SGS Reference **SE186199 R0**
 Date Received **15 Nov 2018**
 Date Reported **22 Nov 2018**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES



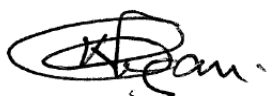
Akheevar Beniamen
 Chemist



Dong Liang
 Metals/Inorganics Team Leader



Huong Crawford
 Production Manager



Kamrul Ahsan
 Senior Chemist



Ly Kim Ha
 Organic Section Head



Shane McDermott
 Inorganic/Metals Chemist

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE186199.001 Water 13 Nov 2018 MB5	SE186199.002 Water 13 Nov 2018 MB6B	SE186199.003 Water 13 Nov 2018 MB9	SE186199.004 Water 13 Nov 2018 MB10
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Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 20/11/2018

TRH C6-C10	µg/L	50	<50	<50	<50	<50
TRH C6-C9	µg/L	40	<40	<40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	112	111	114	106
d4-1,2-dichloroethane (Surrogate)	%	-	112	112	115	107
d8-toluene (Surrogate)	%	-	103	103	106	100
Bromofluorobenzene (Surrogate)	%	-	96	94	93	94

VPH F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 16/11/2018

TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH C10-C36	µg/L	450	<450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650	<650

TRH F Bands

TRH >C10-C16	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500

OC Pesticides in Water Method: AN420 Tested: 16/11/2018

Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1	<0.1

Parameter	Units	LOR	Sample Number	SE186199.001	SE186199.002	SE186199.003	SE186199.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	13 Nov 2018	13 Nov 2018	13 Nov 2018	13 Nov 2018
			Sample Name	MB5	MB6B	MB9	MB10

OC Pesticides in Water Method: AN420 Tested: 16/11/2018 (continued)

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	96	75	67	69
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OP Pesticides in Water Method: AN420 Tested: 16/11/2018

Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	88	78	80	82
d14-p-terphenyl (Surrogate)	%	-	94	94	96	100

Total Phenolics in Water Method: AN289 Tested: 19/11/2018

Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
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pH in water Method: AN101 Tested: 16/11/2018

pH**	No unit	-	6.1	6.0	5.8	5.8
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 16/11/2018

Conductivity @ 25 C	µS/cm	2	1200	1200	410	210
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Parameter	Units	LOR	Sample Number	SE186199.001	SE186199.002	SE186199.003	SE186199.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	13 Nov 2018	13 Nov 2018	13 Nov 2018	13 Nov 2018
			Sample Name	MB5	MB6B	MB9	MB10

Forms of Carbon Method: AN190 Tested: 19/11/2018

Total Organic Carbon as NPOC	mg/L	0.2	5.8	6.0	3.5	1.5
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Alkalinity Method: AN135 Tested: 16/11/2018

Bicarbonate Alkalinity as CaCO ₃	mg/L	5	220	320	98	46
Total Alkalinity as CaCO ₃	mg/L	5	220	320	98	46

Anions by Ion Chromatography in Water Method: AN245 Tested: 19/11/2018

Chloride	mg/L	1	190	180	55	25
Sulfate, SO ₄	mg/L	1	17	35	19	13
Fluoride	mg/L	0.1	<0.10	0.11	<0.10	<0.10
Nitrate Nitrogen, NO ₃ -N	mg/L	0.005	10	<0.005	<0.005	0.27

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 16/11/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	11	0.90	1.7	0.64
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/11/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.18	0.19	0.07	<0.02
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COD in Water Method: AN179/AN181 Tested: 19/11/2018

Chemical Oxygen Demand	mg/L	10	18	27	<10	<10
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Parameter	Units	LOR	Sample Number	SE186199.001	SE186199.002	SE186199.003	SE186199.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	13 Nov 2018	13 Nov 2018	13 Nov 2018	13 Nov 2018
			Sample Name	MB5	MB6B	MB9	MB10

Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 16/11/2018

Hexavalent Chromium, Cr6+	mg/L	0.004	<0.004	<0.004	<0.004	<0.004
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 20/11/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	680	800	270	130
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 19/11/2018

Calcium, Ca	mg/L	0.2	60	71	17	11
Magnesium, Mg	mg/L	0.1	21	56	14	8.5
Potassium, K	mg/L	0.1	49	14	7.8	3.2
Sodium, Na	mg/L	0.5	92	50	27	10

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 16/11/2018

Aluminium, Al	µg/L	5	<5	<5	<5	5
Iron, Fe	µg/L	5	84	580	1700	360
Manganese, Mn	µg/L	1	750	3400	960	56

Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 16/11/2018

Total Chromium	µg/L	1	4	3	1	<1
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Parameter	Sample Number		SE186199.005	SE186199.006
	Sample Matrix		Water	Water
	Sample Date		13 Nov 2018	13 Nov 2018
	Sample Name		MB12	MB14
		Units	LOR	

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 20/11/2018

TRH C6-C10	µg/L	50	130	<50
TRH C6-C9	µg/L	40	130	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	111	111
d4-1,2-dichloroethane (Surrogate)	%	-	113	111
d8-toluene (Surrogate)	%	-	103	103
Bromofluorobenzene (Surrogate)	%	-	89	92

VPF F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	130	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 16/11/2018

TRH C10-C14	µg/L	50	<50	<50
TRH C15-C28	µg/L	200	<200	<200
TRH C29-C36	µg/L	200	<200	<200
TRH C37-C40	µg/L	200	<200	<200
TRH C10-C36	µg/L	450	<450	<450
TRH C10-C40	µg/L	650	<650	<650

TRH F Bands

TRH >C10-C16	µg/L	60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500

OC Pesticides in Water Method: AN420 Tested: 16/11/2018

Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1

Parameter	Sample Number	SE186199.005	SE186199.006
	Sample Matrix	Water	Water
	Sample Date	13 Nov 2018	13 Nov 2018
	Sample Name	MB12	MB14
	Units	LOR	

OC Pesticides in Water Method: AN420 Tested: 16/11/2018 (continued)

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	74	61
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OP Pesticides in Water Method: AN420 Tested: 16/11/2018

Dichlorvos	µg/L	0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	84	70
d14-p-terphenyl (Surrogate)	%	-	100	92

Total Phenolics in Water Method: AN289 Tested: 19/11/2018

Total Phenols	mg/L	0.01	<0.01	<0.01
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pH in water Method: AN101 Tested: 16/11/2018

pH**	No unit	-	5.0	6.6
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 16/11/2018

Conductivity @ 25 C	µS/cm	2	1000	720
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	Sample Number	SE186199.005	SE186199.006
	Sample Matrix	Water	Water
	Sample Date	13 Nov 2018	13 Nov 2018
	Sample Name	MB12	MB14
Parameter	Units	LOR	

Forms of Carbon Method: AN190 Tested: 19/11/2018

Total Organic Carbon as NPOC	mg/L	0.2	4.5	3.4
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Alkalinity Method: AN135 Tested: 16/11/2018

Bicarbonate Alkalinity as CaCO ₃	mg/L	5	48	300
Total Alkalinity as CaCO ₃	mg/L	5	48	300

Anions by Ion Chromatography in Water Method: AN245 Tested: 19/11/2018

Chloride	mg/L	1	230	34
Sulfate, SO ₄	mg/L	1	85	44
Fluoride	mg/L	0.1	<0.10	<0.10
Nitrate Nitrogen, NO ₃ -N	mg/L	0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 16/11/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	2.7	0.20
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/11/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	<0.02	<0.02
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COD in Water Method: AN179/AN181 Tested: 19/11/2018

Chemical Oxygen Demand	mg/L	10	16	<10
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	Sample Number	SE186199.005	SE186199.006
	Sample Matrix	Water	Water
	Sample Date	13 Nov 2018	13 Nov 2018
	Sample Name	MB12	MB14
Parameter	Units	LOR	

Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 16/11/2018

Hexavalent Chromium, Cr6+	mg/L	0.004	<0.004	<0.004
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 20/11/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	640	440
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 19/11/2018

Calcium, Ca	mg/L	0.2	36	90
Magnesium, Mg	mg/L	0.1	24	28
Potassium, K	mg/L	0.1	9.2	8.9
Sodium, Na	mg/L	0.5	56	18

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 16/11/2018

Aluminium, Al	µg/L	5	380	<5
Iron, Fe	µg/L	5	37000	1000
Manganese, Mn	µg/L	1	2100	76

Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 16/11/2018

Total Chromium	µg/L	1	<1	<1
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MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as CaCO ₃	LB161405	mg/L	5	<5	0%	NA
Total Alkalinity as CaCO ₃	LB161405	mg/L	5	<5	0%	115%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB161356	mg/L	0.01	<0.01	0%	99%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride	LB161424	mg/L	1	<0.05	0%	99%	111%
Sulfate, SO ₄	LB161424	mg/L	1	<1.0	0%	98%	99%
Fluoride	LB161424	mg/L	0.1	<0.10	0%	99%	
Nitrate Nitrogen, NO ₃ -N	LB161424	mg/L	0.005	<0.005	1%	98%	98%

COD in Water Method: ME-(AU)-[ENV]AN179/AN181

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chemical Oxygen Demand	LB161432	mg/L	10	<10	0 - 4%	98%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB161377	µS/cm	2	<2	0%	98%

Forms of Carbon Method: ME-(AU)-[ENV]AN190

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon as NPOC	LB161419	mg/L	0.2	<0.2	1%	101%	99%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Hexavalent Chromium in water by Discrete Analyser Method: ME-(AU)-[ENV]AN283

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Hexavalent Chromium, Cr6+	LB161357	mg/L	0.004	<0.004	0%	105%	100%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB161438	mg/L	0.2	<0.2	0 - 1%	100%	89%
Magnesium, Mg	LB161438	mg/L	0.1	<0.1	0 - 2%	101%	
Potassium, K	LB161438	mg/L	0.1	<0.1	1%	99%	
Sodium, Na	LB161438	mg/L	0.5	<0.5	1%	102%	

OC Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Hexachlorobenzene (HCB)	LB161382	µg/L	0.1	<0.1	0%	NA
Alpha BHC	LB161382	µg/L	0.1	<0.1	0%	NA
Lindane (gamma BHC)	LB161382	µg/L	0.1	<0.1	0%	NA
Heptachlor	LB161382	µg/L	0.1	<0.1	0%	88%
Aldrin	LB161382	µg/L	0.1	<0.1	0%	76%
Beta BHC	LB161382	µg/L	0.1	<0.1	0%	NA
Delta BHC	LB161382	µg/L	0.1	<0.1	0%	89%
Heptachlor epoxide	LB161382	µg/L	0.1	<0.1	0%	NA
o,p'-DDE	LB161382	µg/L	0.1	<0.1	0%	NA
Alpha Endosulfan	LB161382	µg/L	0.1	<0.1	0%	NA
Gamma Chlordane	LB161382	µg/L	0.1	<0.1	0%	NA
Alpha Chlordane	LB161382	µg/L	0.1	<0.1	0%	NA
trans-Nonachlor	LB161382	µg/L	0.1	<0.1	0%	NA
p,p'-DDE	LB161382	µg/L	0.1	<0.1	0%	NA
Dieldrin	LB161382	µg/L	0.1	<0.1	0%	93%
Endrin	LB161382	µg/L	0.1	<0.1	0%	90%
o,p'-DDD	LB161382	µg/L	0.1	<0.1	0%	NA
o,p'-DDT	LB161382	µg/L	0.1	<0.1	0%	NA
Beta Endosulfan	LB161382	µg/L	0.1	<0.1	0%	NA
p,p'-DDD	LB161382	µg/L	0.1	<0.1	0%	NA
p,p'-DDT	LB161382	µg/L	0.1	<0.1	0%	84%
Endosulfan sulphate	LB161382	µg/L	0.1	<0.1	0%	NA
Endrin aldehyde	LB161382	µg/L	0.1	<0.1	0%	NA
Methoxychlor	LB161382	µg/L	0.1	<0.1	0%	NA
Endrin ketone	LB161382	µg/L	0.1	<0.1	0%	NA
Isodrin	LB161382	µg/L	0.1	<0.1	0%	NA
Mirex	LB161382	µg/L	0.1	<0.1	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Tetrachloro-m-xylene (TCMX) (Surrogate)	LB161382	%	-	96%	3 - 18%	70%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

OP Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Dichlorvos	LB161382	µg/L	0.5	<0.5	0%	98%
Dimethoate	LB161382	µg/L	0.5	<0.5	0%	NA
Diazinon (Dimpylate)	LB161382	µg/L	0.5	<0.5	0%	99%
Fenitrothion	LB161382	µg/L	0.2	<0.2	0%	NA
Malathion	LB161382	µg/L	0.2	<0.2	0%	NA
Chlorpyrifos (Chlorpyrifos Ethyl)	LB161382	µg/L	0.2	<0.2	0%	99%
Parathion-ethyl (Parathion)	LB161382	µg/L	0.2	<0.2	0%	NA
Bromophos Ethyl	LB161382	µg/L	0.2	<0.2	0%	NA
Methidathion	LB161382	µg/L	0.5	<0.5	0%	NA
Ethion	LB161382	µg/L	0.2	<0.2	0%	97%
Azinphos-methyl	LB161382	µg/L	0.2	<0.2	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
2-fluorobiphenyl (Surrogate)	LB161382	%	-	92%	2%	68%
d14-p-terphenyl (Surrogate)	LB161382	%	-	96%	4%	88%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB161377	No unit	-	0 - 1%	99%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB161575	mg/L	10	<10	4 - 7%	100%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total Phenolics in Water Method: ME-(AU)-[ENV]AN289

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phenols	LB161418	mg/L	0.01	<0.01	12%	101%	99%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB161627	mg/L	0.02	<0.02	7%	111%	109%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB161413	µg/L	5	<5	0%	113%	102%
Iron, Fe	LB161413	µg/L	5	<5	2%	110%	
Manganese, Mn	LB161413	µg/L	1	<1	2%	108%	

Trace Metals (Total) in Water by ICPMS Method: ME-(AU)-[ENV]AN022/AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Chromium	LB161414	µg/L	1	<1	0%	NA

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH C10-C14	LB161382	µg/L	50	<50	0%	94%
TRH C15-C28	LB161382	µg/L	200	<200	0%	122%
TRH C29-C36	LB161382	µg/L	200	<200	0%	121%
TRH C37-C40	LB161382	µg/L	200	<200	0%	NA
TRH C10-C36	LB161382	µg/L	450	<450	0%	NA
TRH C10-C40	LB161382	µg/L	650	<650	0%	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH >C10-C16	LB161382	µg/L	60	<60	0%	104%
TRH >C16-C34 (F3)	LB161382	µg/L	500	<500	0%	123%
TRH >C34-C40 (F4)	LB161382	µg/L	500	<500	0%	123%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH C6-C10	LB161545	µg/L	50	<50	0 - 2%	99%	84%
TRH C6-C9	LB161545	µg/L	40	<40	0 - 4%	93%	83%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB161545	%	-	107%	0 - 12%	96%	90%
d4-1,2-dichloroethane (Surrogate)	LB161545	%	-	108%	0 - 10%	97%	91%
d8-toluene (Surrogate)	LB161545	%	-	101%	4 - 5%	97%	95%
Bromofluorobenzene (Surrogate)	LB161545	%	-	89%	8 - 15%	95%	95%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene (F0)	LB161545	µg/L	0.5	<0.5	0%	NA	NA
TRH C6-C10 minus BTEX (F1)	LB161545	µg/L	50	<50	0 - 2%	98%	78%

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN022	The water sample is digested with Nitric Acid and made up to the original volume similar to APHA3030E.
AN022/AN318	Following acid digestion of un filtered sample, determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN113	The Total Dissolved Solids residue may also be ignited at 550 C and volatile TDS (Organic TDS) and non-volatile TDS (Inorganic) can be determined.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN181	Analysis of COD by Semi Closed Reflux: The sample is refluxed with strong acid and a known excess of oxidant. After digestion the unreduced oxidant is back titrated to determine the amount of oxidant consumed. The chemically oxidised matter is calculated in terms of oxygen equivalents. Reference APHA 5220 B.
AN190	TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO ₂ is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
AN190	Chemical oxygen demand can be calculated/estimated based on the O ₂ /C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO ₂ , NO ₃ and SO ₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K ₂ SO ₄ and CuSO ₄ . All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.

METHOD

METHODOLOGY SUMMARY

AN283	Hexavalent Chromium via Aquakem DA: Soluble hexavalent chromium forms a red/violet colour with diphenylcarbazide in acidic solution. This procedure is very sensitive and nearly specific for Cr6+. If total chromium is also measured the trivalent form of chromium Cr3+ can be calculated from the difference (Total Cr - Cr6+). Reference APHA3500CrB.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC's are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- 1 Bq is equivalent to 27 pCi
- 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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Project **217500 - Lithgow SWF**
 Order Number **FJ1542**
 Samples **1**

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 Date Reported **22 Nov 2018**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES



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Sample Number SE186200.001
Sample Matrix Water
Sample Date 13 Nov 2018
Sample Name LW1

Parameter Units LOR

Total Phenolics in Water Method: AN289 Tested: 19/11/2018

Total Phenols	mg/L	0.01	<0.01
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pH in water Method: AN101 Tested: 16/11/2018

pH**	No unit	-	6.6
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 16/11/2018

Conductivity @ 25 C	µS/cm	2	1100
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 20/11/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	600
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Forms of Carbon Method: AN190 Tested: 19/11/2018

Total Organic Carbon as NPOC	mg/L	0.2	5.5
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Alkalinity Method: AN135 Tested: 16/11/2018

Bicarbonate Alkalinity as CaCO ₃	mg/L	5	140
Total Alkalinity as CaCO ₃	mg/L	5	140

Sample Number SE186200.001
 Sample Matrix Water
 Sample Date 13 Nov 2018
 Sample Name LW1

Parameter	Units	LOR
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Anions by Ion Chromatography in Water Method: AN245 Tested: 19/11/2018

Fluoride	mg/L	0.1	0.17
Chloride	mg/L	1	230
Nitrate Nitrogen, NO3-N	mg/L	0.005	0.53
Sulfate, SO4	mg/L	1	18

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 16/11/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.18
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COD in Water Method: AN179/AN181 Tested: 19/11/2018

Chemical Oxygen Demand	mg/L	10	15
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BOD5 Method: AN183 Tested: 16/11/2018

Biochemical Oxygen Demand (BOD5)	mg/L	5	<5
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TKN Kjeldahl Digestion by Discrete Analyser Method: AN281/AN292(Sydney only) Tested: 22/11/2018

Total Kjeldahl Nitrogen	mg/L	0.05	0.43
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Oil and Grease in Water Method: AN185 Tested: 20/11/2018

Oil and Grease	mg/L	5	<5
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		Sample Number	SE186200.001
		Sample Matrix	Water
		Sample Date	13 Nov 2018
		Sample Name	LW1
Parameter	Units	LOR	

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 20/11/2018

Total Suspended Solids Dried at 103-105°C	mg/L	5	5
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 19/11/2018

Calcium, Ca	mg/L	0.2	58
Magnesium, Mg	mg/L	0.1	20
Potassium, K	mg/L	0.1	29
Sodium, Na	mg/L	0.5	97

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 16/11/2018

Iron, Fe	µg/L	5	62
Manganese, Mn	µg/L	1	620

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as CaCO ₃	LB161405	mg/L	5	<5	0%	NA
Total Alkalinity as CaCO ₃	LB161405	mg/L	5	<5	0%	115%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB161356	mg/L	0.01	<0.01	0%	99%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Fluoride	LB161424	mg/L	0.1	<0.10	0%	99%	
Chloride	LB161424	mg/L	1	<0.05	0%	99%	111%
Nitrate Nitrogen, NO ₃ -N	LB161424	mg/L	0.005	<0.005	1%	98%	98%
Sulfate, SO ₄	LB161424	mg/L	1	<1.0	0%	98%	99%

BOD5 Method: ME-(AU)-[ENV]AN183

Parameter	QC Reference	Units	LOR	DUP %RPD
Biochemical Oxygen Demand (BOD ₅)	LB161402	mg/L	5	0%

COD in Water Method: ME-(AU)-[ENV]AN179/AN181

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chemical Oxygen Demand	LB161432	mg/L	10	<10	0 - 4%	98%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB161377	µS/cm	2	<2	0%	98%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Forms of Carbon Method: ME-(AU)-[ENV]AN190

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon as NPOC	LB161419	mg/L	0.2	<0.2	1%	101%	99%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB161438	mg/L	0.2	<0.2	0 - 1%	100%	89%
Magnesium, Mg	LB161438	mg/L	0.1	<0.1	0 - 2%	101%	
Potassium, K	LB161438	mg/L	0.1	<0.1	1%	99%	
Sodium, Na	LB161438	mg/L	0.5	<0.5	1%	102%	

Oil and Grease in Water Method: ME-(AU)-[ENV]AN185

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Oil and Grease	LB161536	mg/L	5	<5	81%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB161377	No unit	-	0 - 1%	99%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281/AN292(Sydney only)

Parameter	QC Reference	Units	LOR	MS %Recovery
Total Kjeldahl Nitrogen	LB161720	mg/L	0.05	81%

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB161535	mg/L	5	<5	0%	101%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB161575	mg/L	10	<10	4 - 7%	100%

Total Phenolics in Water Method: ME-(AU)-[ENV]AN289

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phenols	LB161418	mg/L	0.01	<0.01	12%	101%	99%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Iron, Fe	LB161413	µg/L	5	<5	2%	110%	
Manganese, Mn	LB161413	µg/L	1	<1	2%	108%	102%

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN113	The Total Dissolved Solids residue may also be ignited at 550 C and volatile TDS (Organic TDS) and non-volatile TDS (Inorganic) can be determined.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN181	Analysis of COD by Semi Closed Reflux: The sample is refluxed with strong acid and a known excess of oxidant. After digestion the unreacted oxidant is back titrated to determine the amount of oxidant consumed. The chemically oxidised matter is calculated in terms of oxygen equivalents. Reference APHA 5220 B.
AN183	BOD: Serial dilutions of the sample are firstly combined with various reagents to aid bacterial growth and the sample is incubated for 5 days at 20°C. The difference between the initial and final oxygen contents of the sample is the amount of oxygen consumed by the bacteria. This is related to the organic loading of the sample therefore cBOD is the measure of the digestibility or bioavailability of organic matter in the sample. Reference APHA 5210 B. Internal Reference AN183
AN185	Gravimetric Oil & Grease and Hydrocarbons: A known volume of sample is extracted using an organic solvent and the solvent layer with dissolved oils and greases is transferred to a pre-weighed beaker. The solvent is evaporated over low heating and the beaker reweighed. The concentration of oil and grease is determined by the increase in mass of the collection beaker per volume of sample extracted. O&G is suitable for lubricating oils and other high boiling point products but is not suitable for volatiles. Reference to APHA 5520 B and USEPA 1664 Revision B.. Internal Reference AN185
AN190	TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO2 is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
AN190	Chemical oxygen demand can be calculated/estimated based on the O2/C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.

METHOD

METHODOLOGY SUMMARY

AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO ₂ , NO ₃ and SO ₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN281	An unfiltered water or soil sample is first digested in a block digester with sulfuric acid, K ₂ SO ₄ and CuSO ₄ . The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH, and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO ₂ D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- 1 Bq is equivalent to 27 pCi
- 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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